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Computing Everywhere: Harnessing the Internet for Networked Appliances

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An SAIC Company

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Coming up…

- Networked Appliances technology today
- Networked Appliances → Internet Personal Appliances
- Infrastructure for harnessing the Internet
  - SIP++ for Internet Personal Appliance control
  - "Talisman" micro-location service
  - OSGi platform
- Lab "demo" – Internet Personal Appliances in Action
- Conclusions

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Networked Appliances in the News...

Yankee Group*, a Boston market-research firm, estimates that the number of homes in the U.S. with multiple, linked computers will grow from 650,000 in 1999 to over 10 million by 2003.*

Smart Appliances Market Set to Surge (Bear Stearns – 03/27/01)

The most sophisticated wired home combine home networking with computerized control of lighting, heating and security systems -- a market that has already reached **$2 billion.** The most promising appliances in the pipeline are those that reduce energy costs by turning themselves off when not in use. (Yankee Group*)

(In-stat Group – 04/04/01) Total IA sales will jump from $219 million in 2000 to $1.3 billion in 2005. Much of the growth will occur outside of the PC-centric North American and Western European markets.

*Source: April 9, 2001 issue of "On Magazine"

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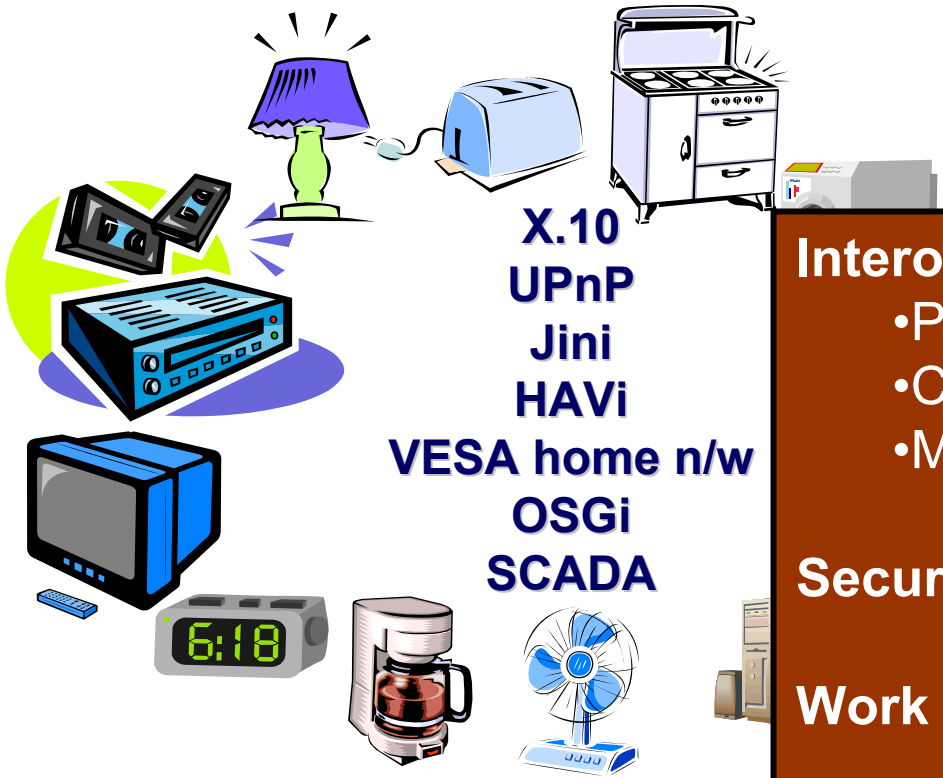
Networking Appliances Today…
A Multitude of Devices and Technologies…



X.10
UPnP
Jini
HAVi
VESA home n/w
OSGi
SCADA

Interoperability Issues
- Protocols
- Capabilities
- Management

Security Issues

Work in single domain only

User-oriented only

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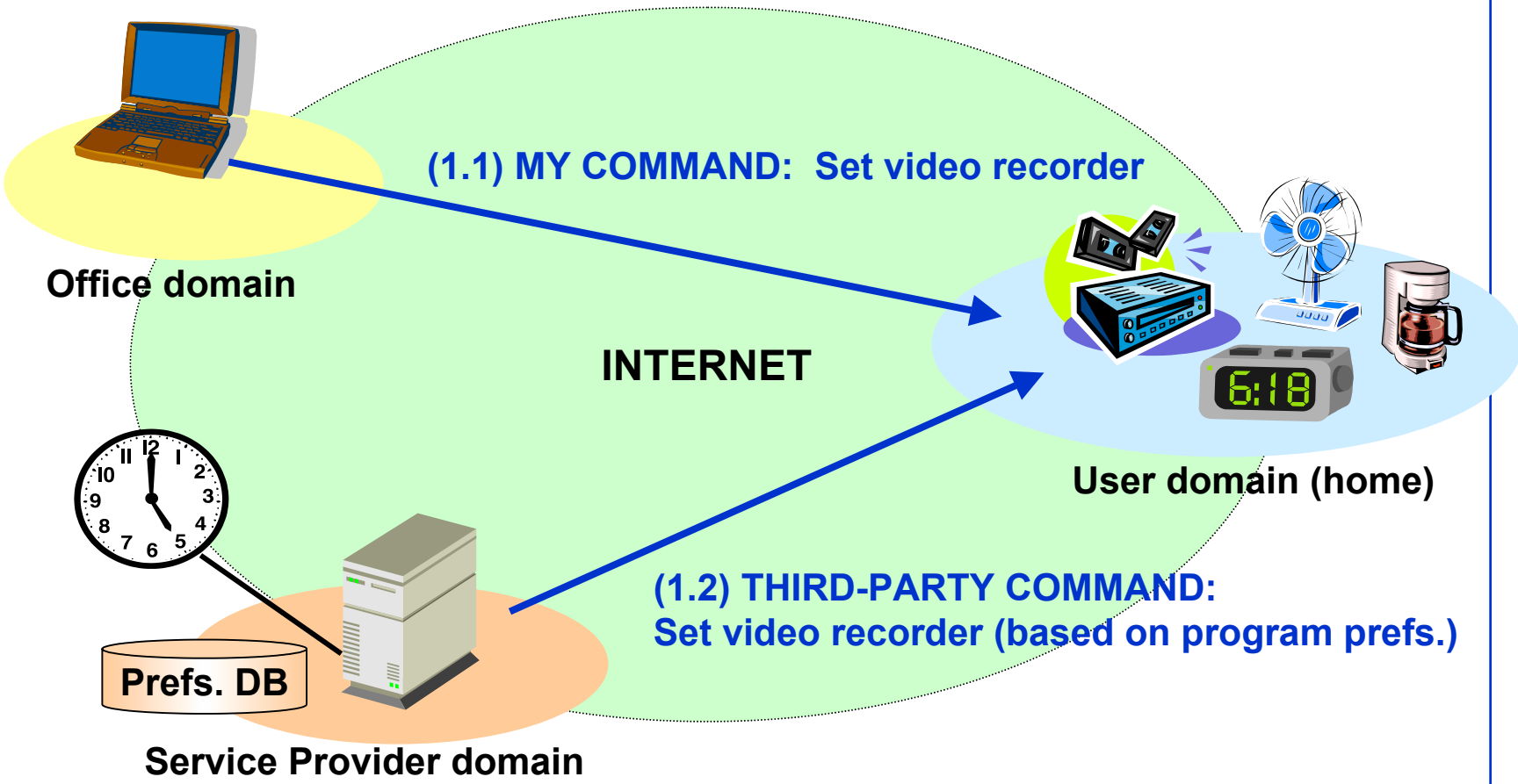
Networking Appliances Tomorrow...
Example (1) Remote Control



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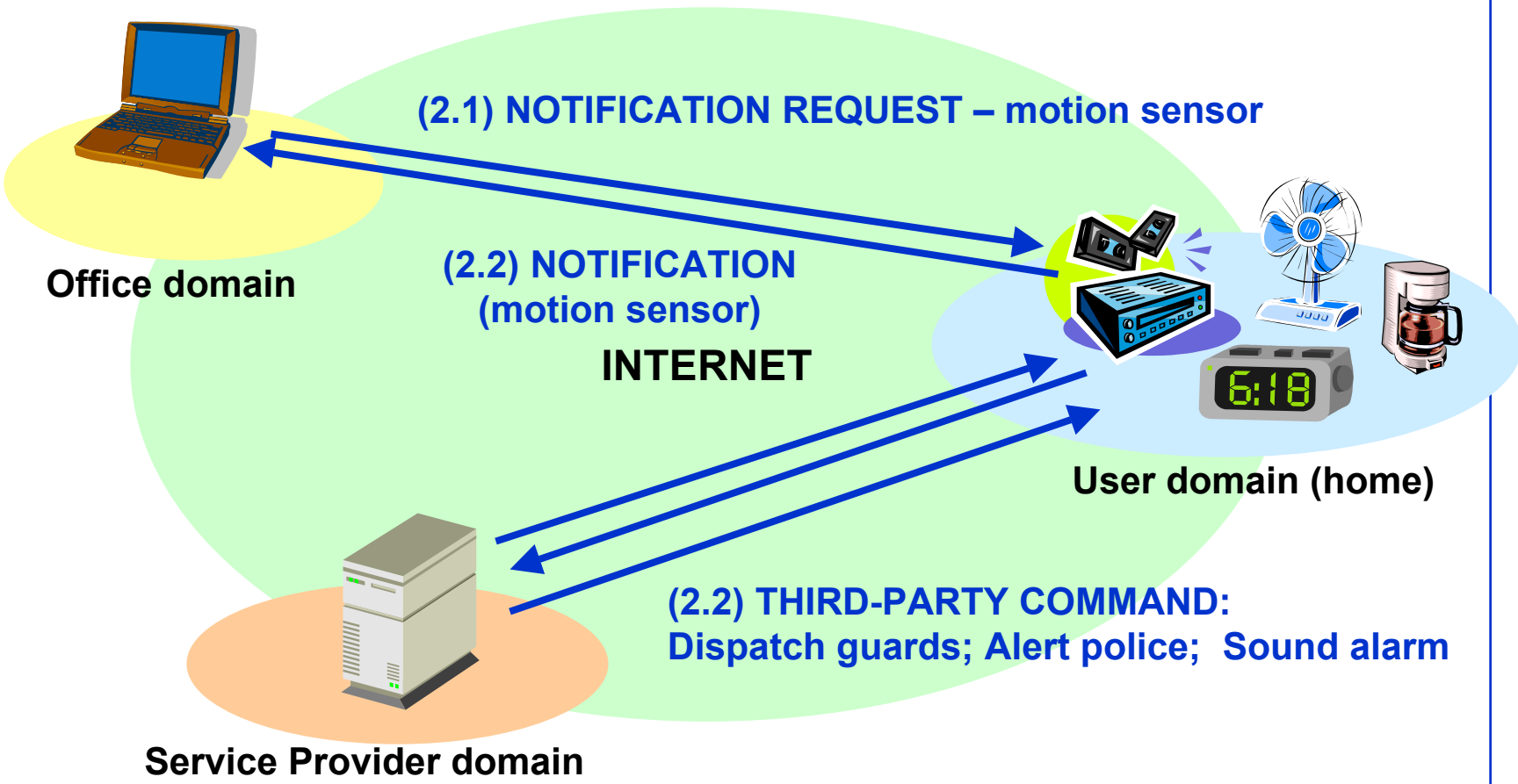
Networking Appliances Tomorrow...
Example (2) Remote Monitoring



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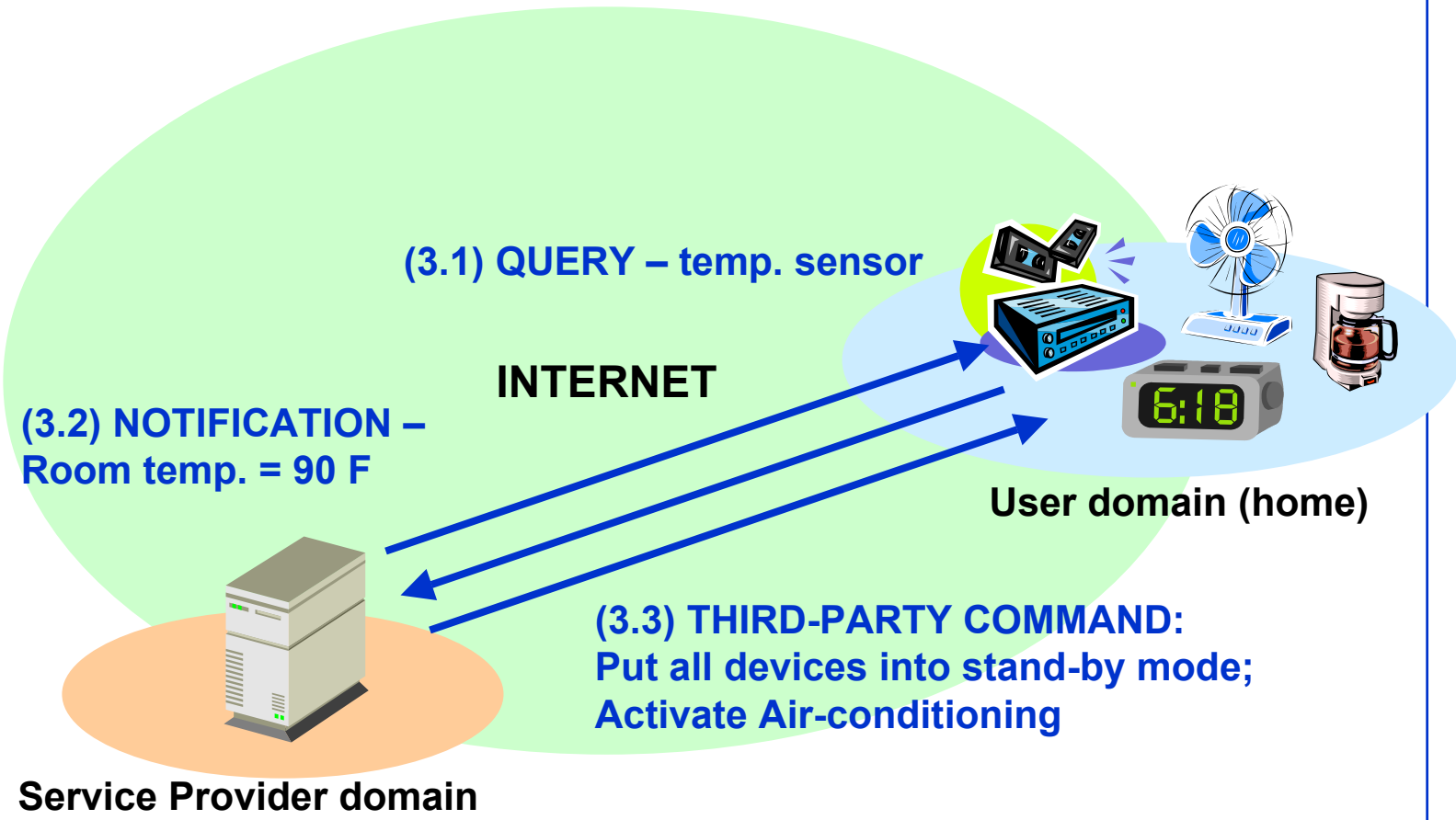
Example (3) Event Notifications



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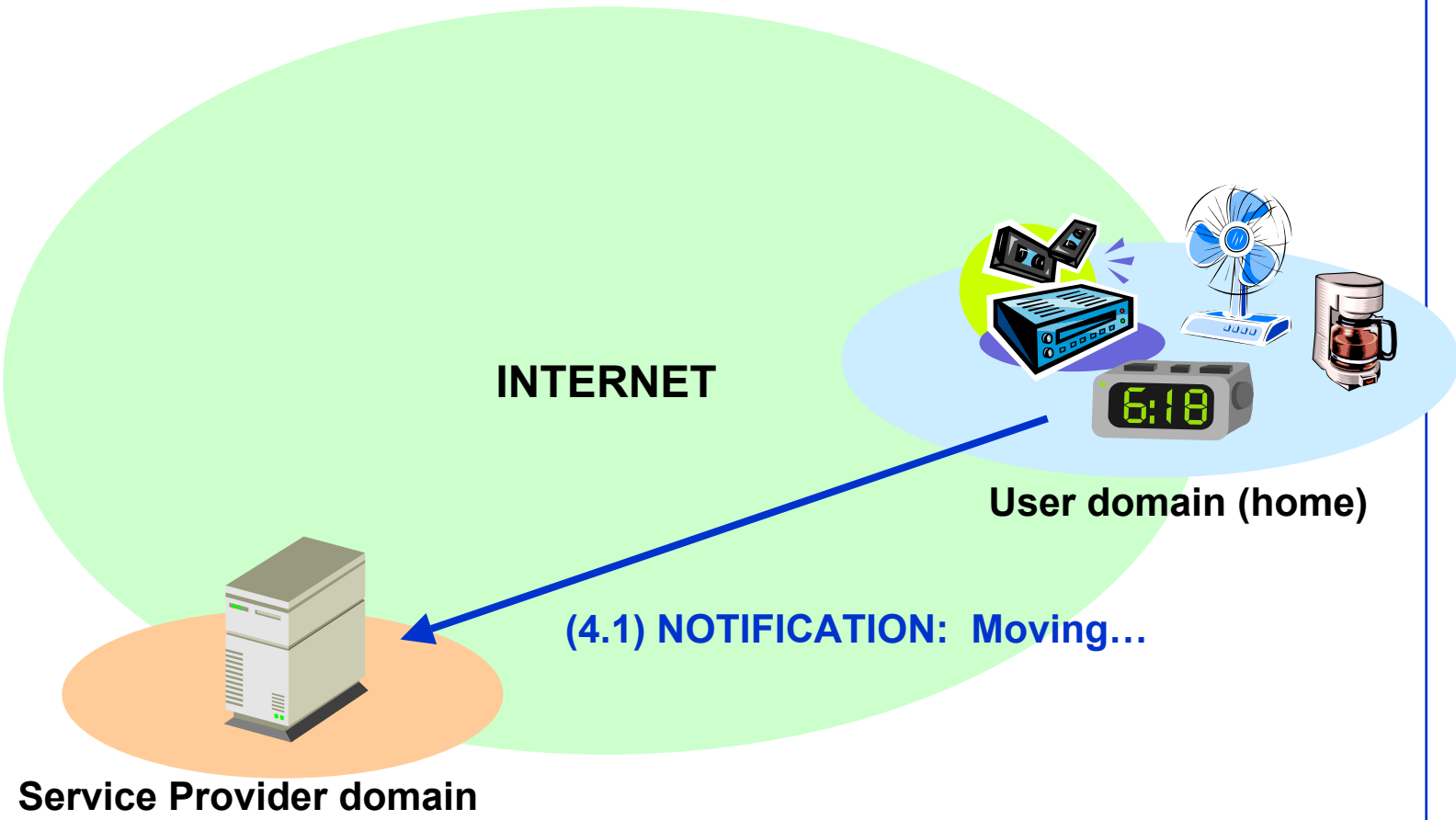
Example (4)… Appliance Mobility & Configuration



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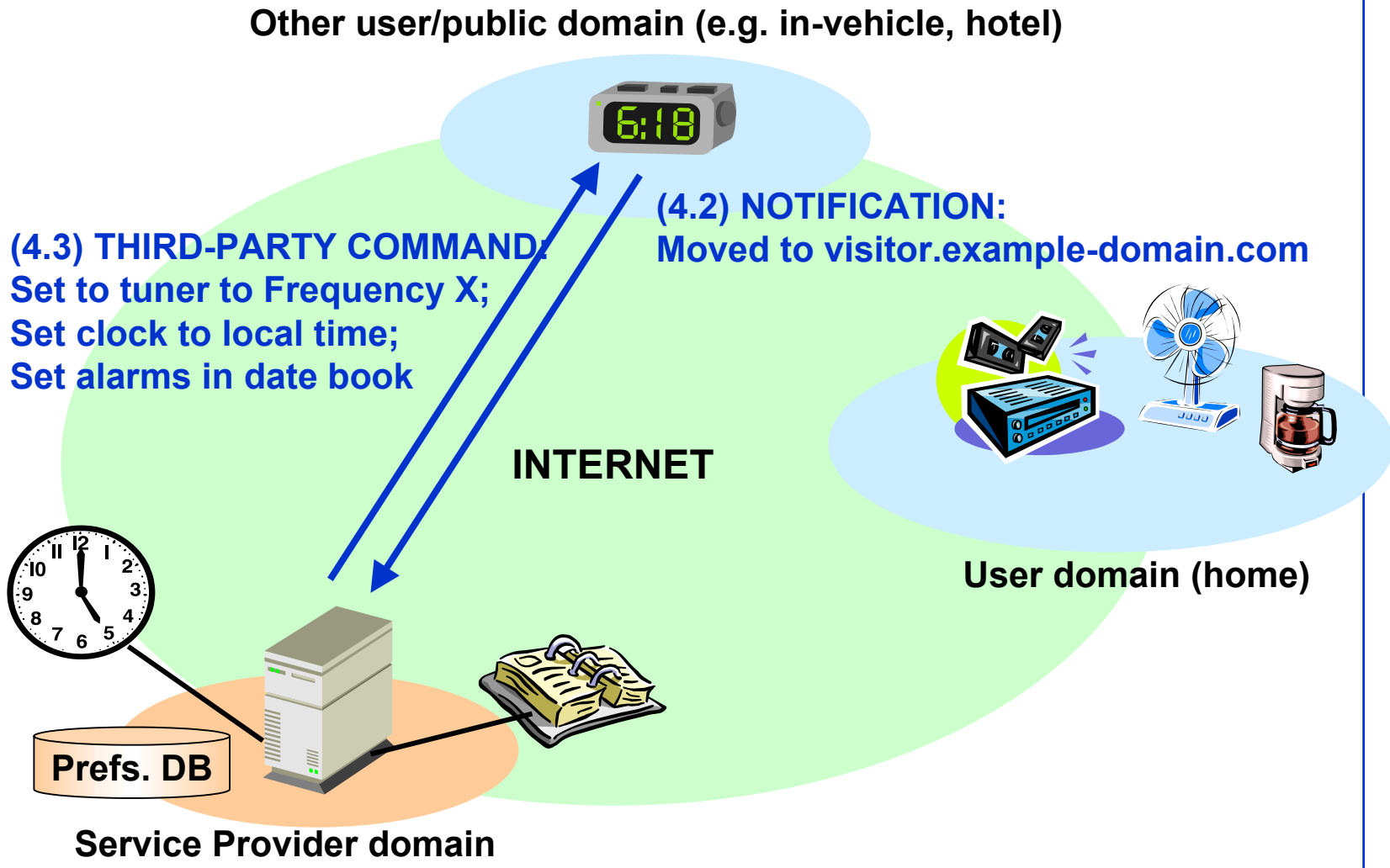

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SUMMARY – Internet Appliance Requirements

- Communication
  - Command and control
  - Query (status, capabilities, etc.)
  - Notification of events
  - Sessions/Media Streaming
  - Device mobility, Service portability
    - Location/domain registrations
- Security
  - Authentication needed (probably need encryption too)
  - Policy-based access
- Protocol 'Footprint' requirements
  - Must be lightweight
  - Preferably *connectionless* protocol

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What is an Internet Personal Appliance (IPA)?

- (Working definition from “in progress” IETF activities)
- A networked device with
  - Dedicated functionality, limited configurability, and optimized UI
  - Ability to interact with the physical environment through sensors & actuators
  - Limited (or restricted) **general-purpose** computational power
- A.k.a. networked appliances, Internet appliances, IP appliances, networked devices, …

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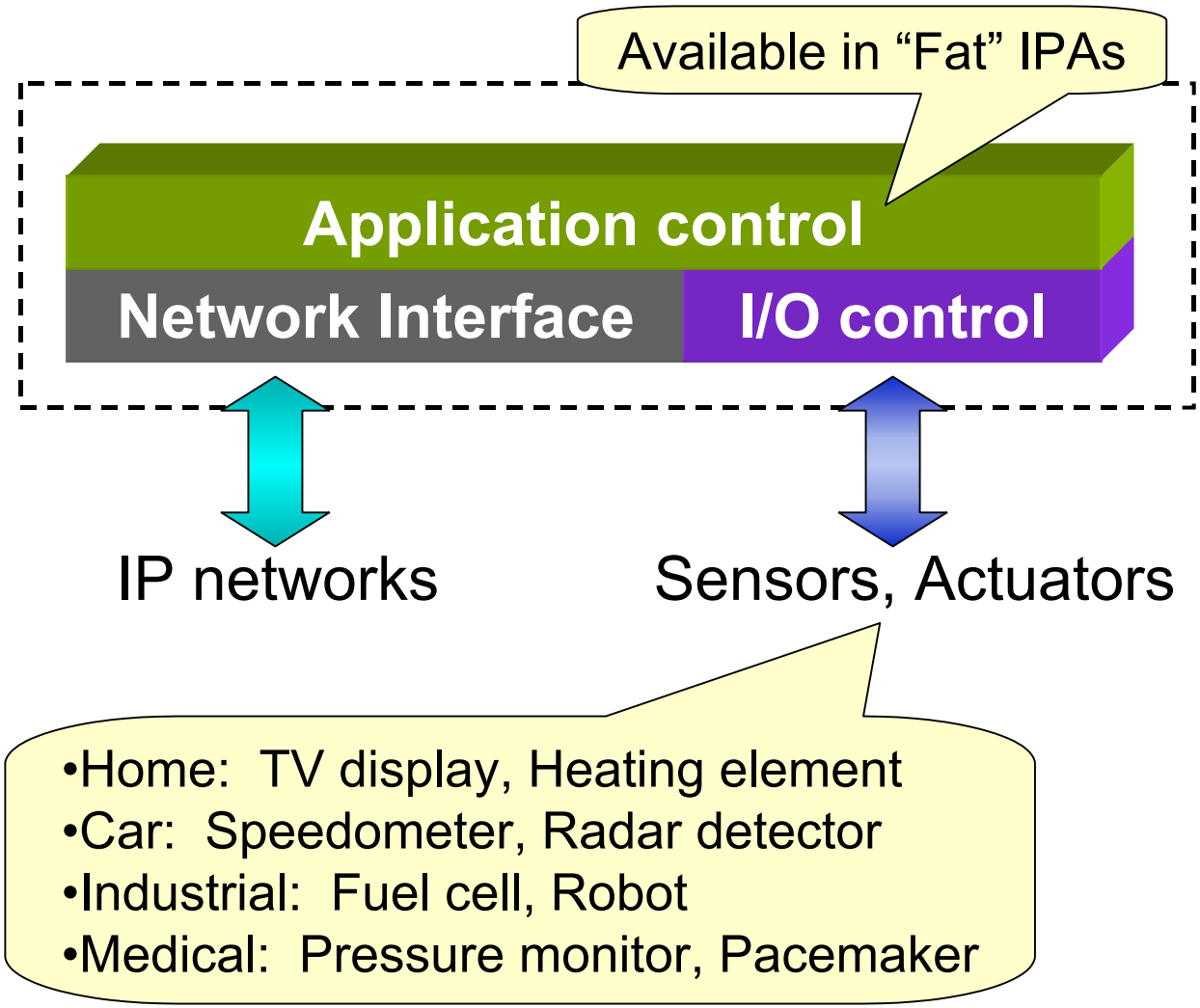
Anatomy of an IPA...



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IPA Networked Functions

Optional.

- Discovery
- Registration

IPA Discovery Client	IPA Discovery Server
IPA Registration Client	IPA Registration Server

- Session Control
- IPA (Actuator) Control
- Status
- Event

IPA Session Client	IPA Session Server
IPA Control Client	IPA Control Server
IPA Status Client	IPA Status Server
IPA Event Client	IPA Event Server

An IPA requires at least ONE of these SERVER functions

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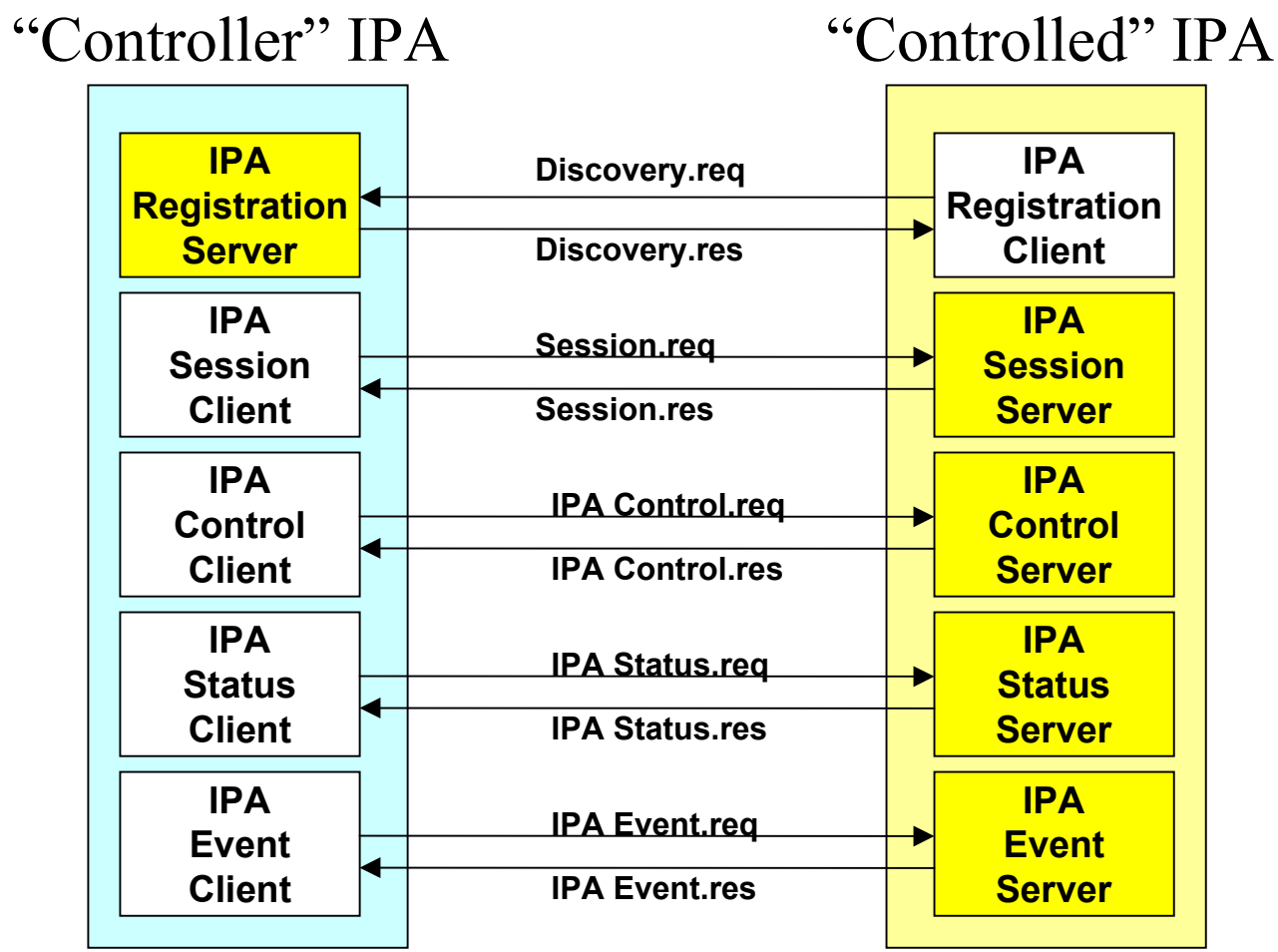
Scenario 1 - IPA-IPA Master-Slave Control



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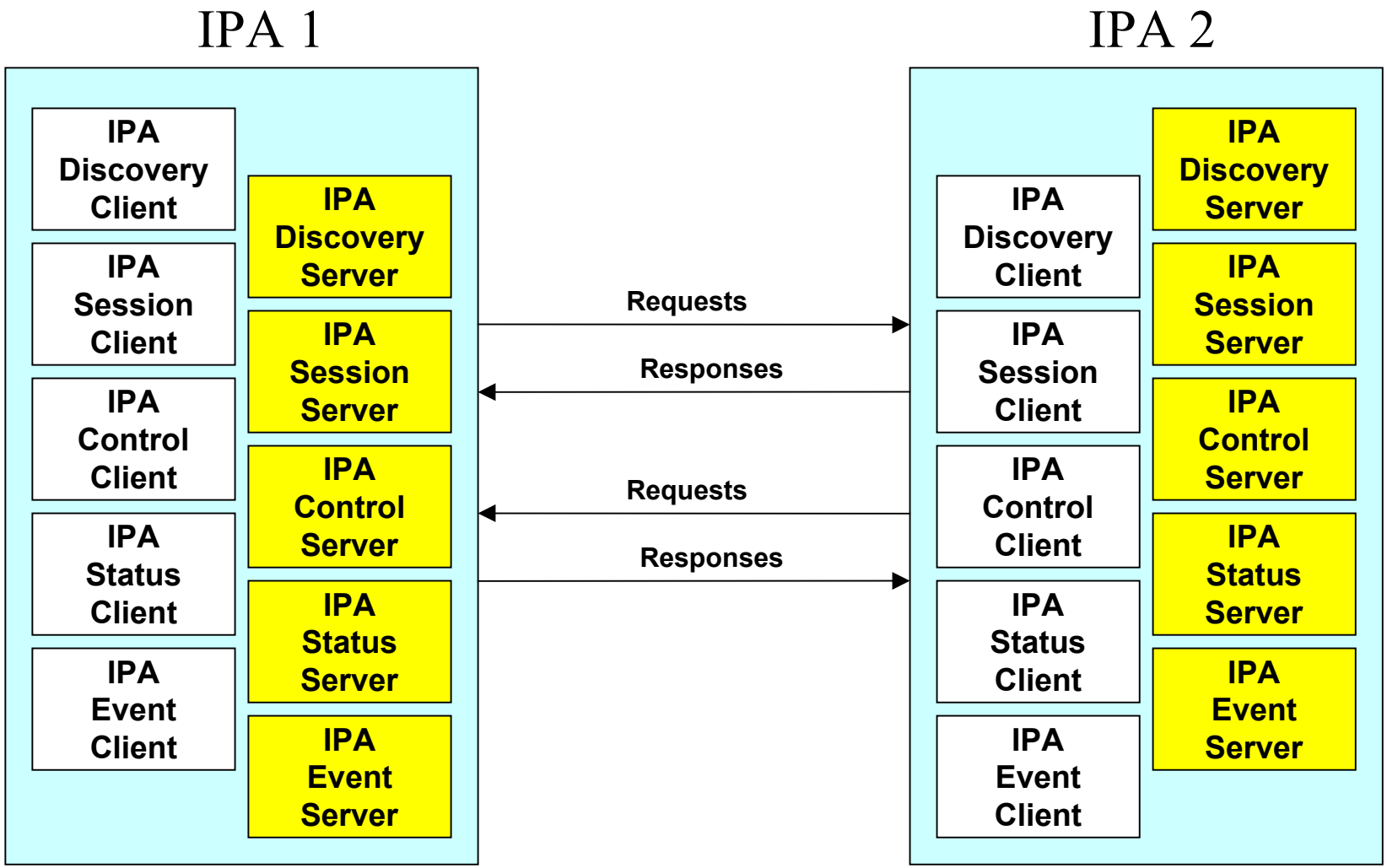
Scenario 2 – "Full" IPA-IPA (Peer-to-Peer) Control



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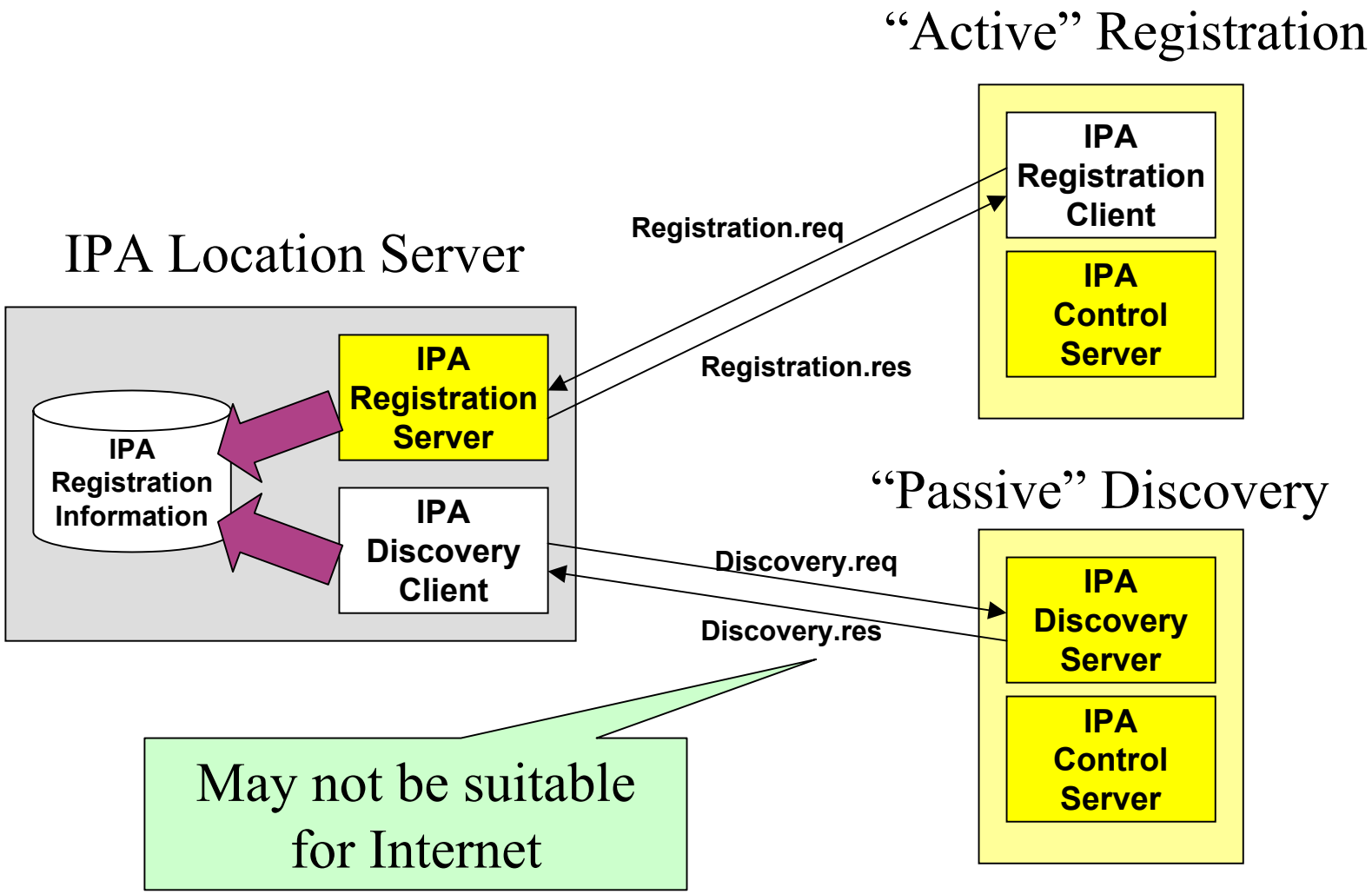
Scenario 3 – IPA-Location Server Options



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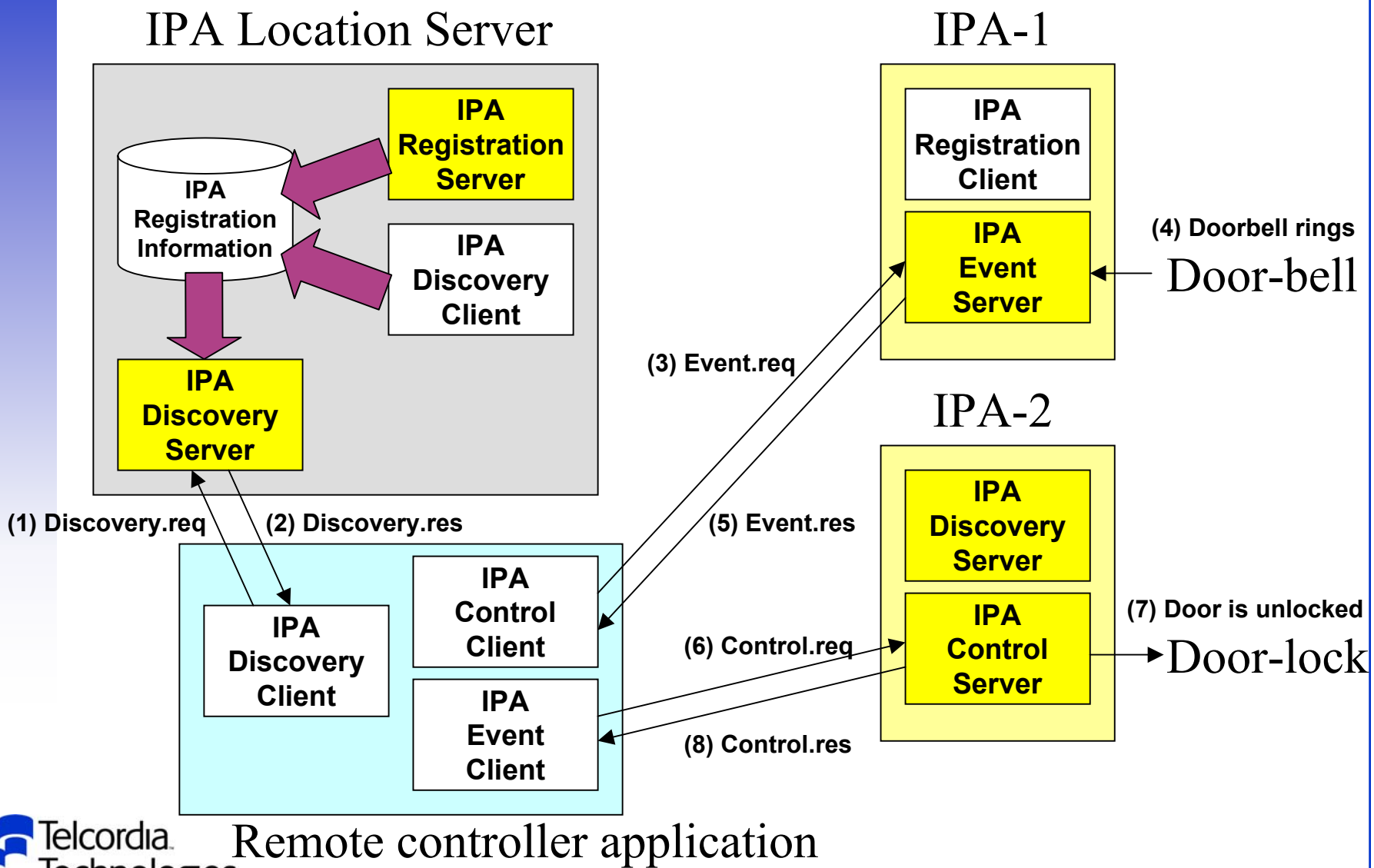
Scenario 4 – Remote Control of IPAs – wait for door-bell ring, and unlock door-lock



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SIP Background...
What is SIP?

- Based on HTTP-like syntax. Intended as a PEER-TO-PEER protocol for internet Multimedia conferencing. Can be used in connectionless mode (application layer reliability).
- User Agents (endpoints) INVITE other User Agents to join a session
- Proxies (intermediates) pass along messages, possibly re-directing them
  - Address translation – follow-me or local name translation
  - Forking of INVITE – multiple alerts
  - Stateless Proxy – firewall pass-thru
- URI-style addressing
  - Friendly addresses e.g. simon.tsang@telcordia.com
- SDP (RFC 2327) payload in SIP INVITE message
  - Varies according to message, and can be any MIME type

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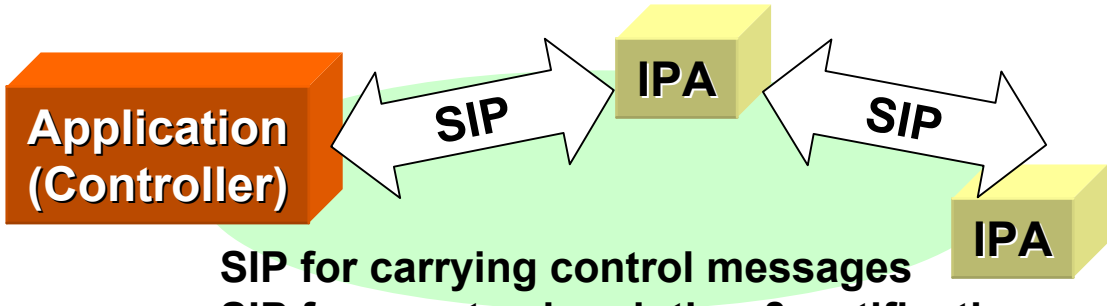
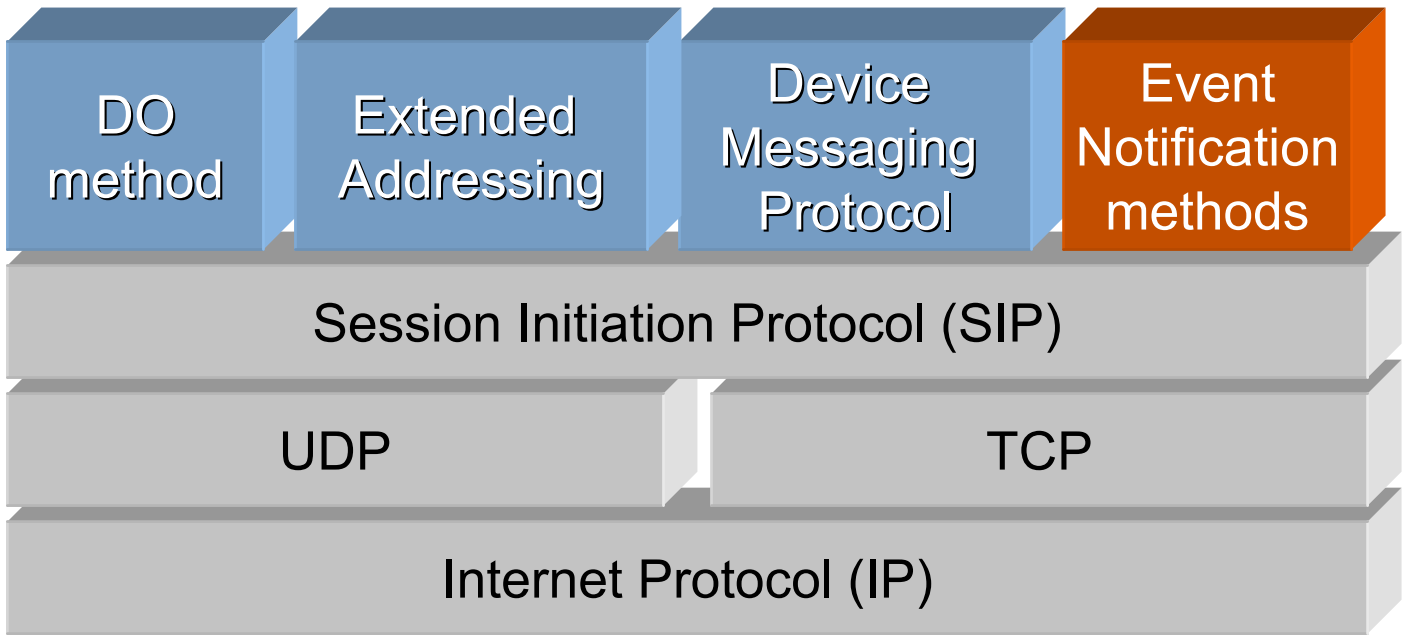
SIP++ for Internet Personal Appliance Control



SIP for carrying control messages
SIP for event subscription & notification
SIP for mobility



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SIP++ for Internet Personal Appliance Control WHY?

- SIP benefits
  - Flexible addressing, hop-by-hop address resolution, independent of transport/network infrastructure
  - SIP security mechanisms (authentication, encryption)
  - SIP event notification mechanism
  - Terminal mobility (re-registrations)
- SIP is already becoming widely deployed for VoIP applications
  - Leverage existing management and operations systems.
  - Leverage existing expertise/skills in SIP.
  - This is just another value-added application using SIP.
- **Using SIP, we can use the INTERNET to transport control messages securely to IPAs.**

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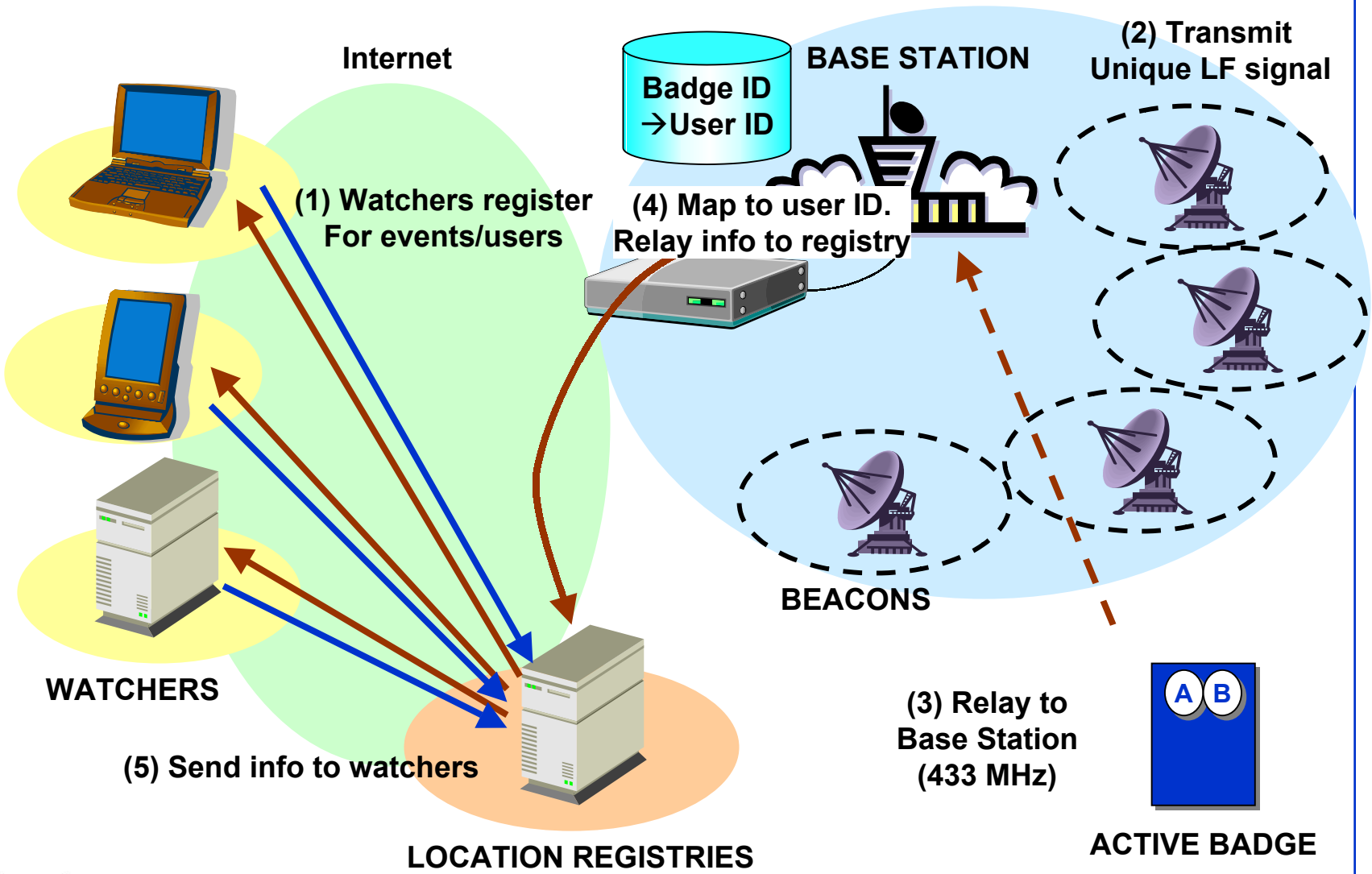
TALISMAN – Micro-Location Service



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TALISMAN - Novel Aspects

- Micro-location information
- **Low-cost**, **scalable** system (no data hotspots) available to any application.
- Ability to see **who is requesting** location information and, in future, to prevent entities from registering.
- **No historical information** held in the system.
- Can be easily extended to use **other sensor** infrastructures.
- Highly **resilient** to point failure through optional redundancy.
- Very very **cheap** for high coverage.

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OSGi

- The Open Services Gateway initiative (OSGi) seeks to define the APIs for a **standard service delivery platform**.
  - Initially proposed as a gateway between the many wide-area networking standards and the many in-home networking standards
  - Now being pursued as a gateway for in-vehicle networks as part of the Vehicle Expert Group (VEG) within OSGi
- Expert Groups:
  - ***Architecture***, Core Platform, ***Device***, Marketing, ***Remote Management***, Security, Vehicle
- http://www.osgi.org/

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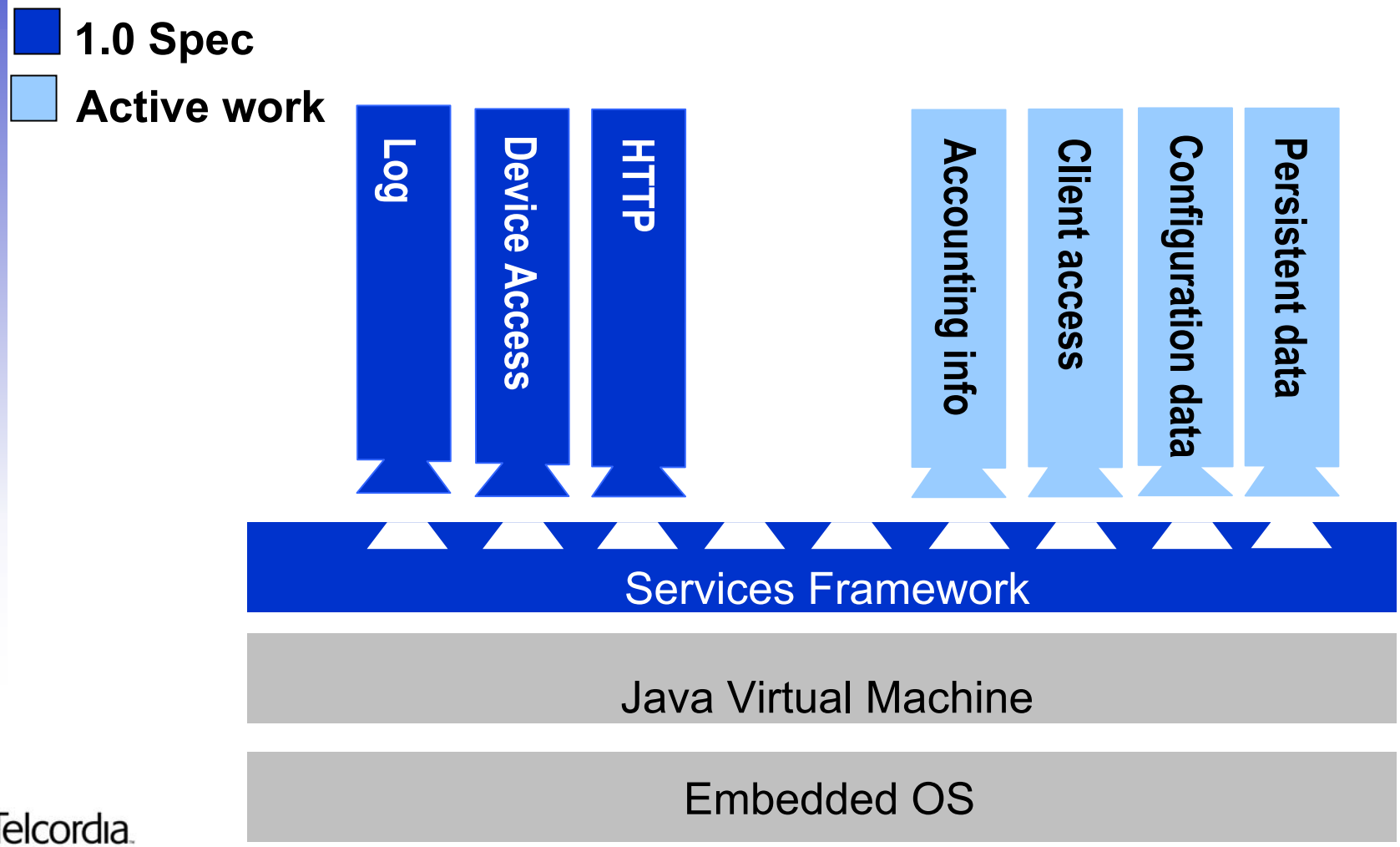
OSGi Service Platform API



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From our lab…

Internet Personal Appliances In Action

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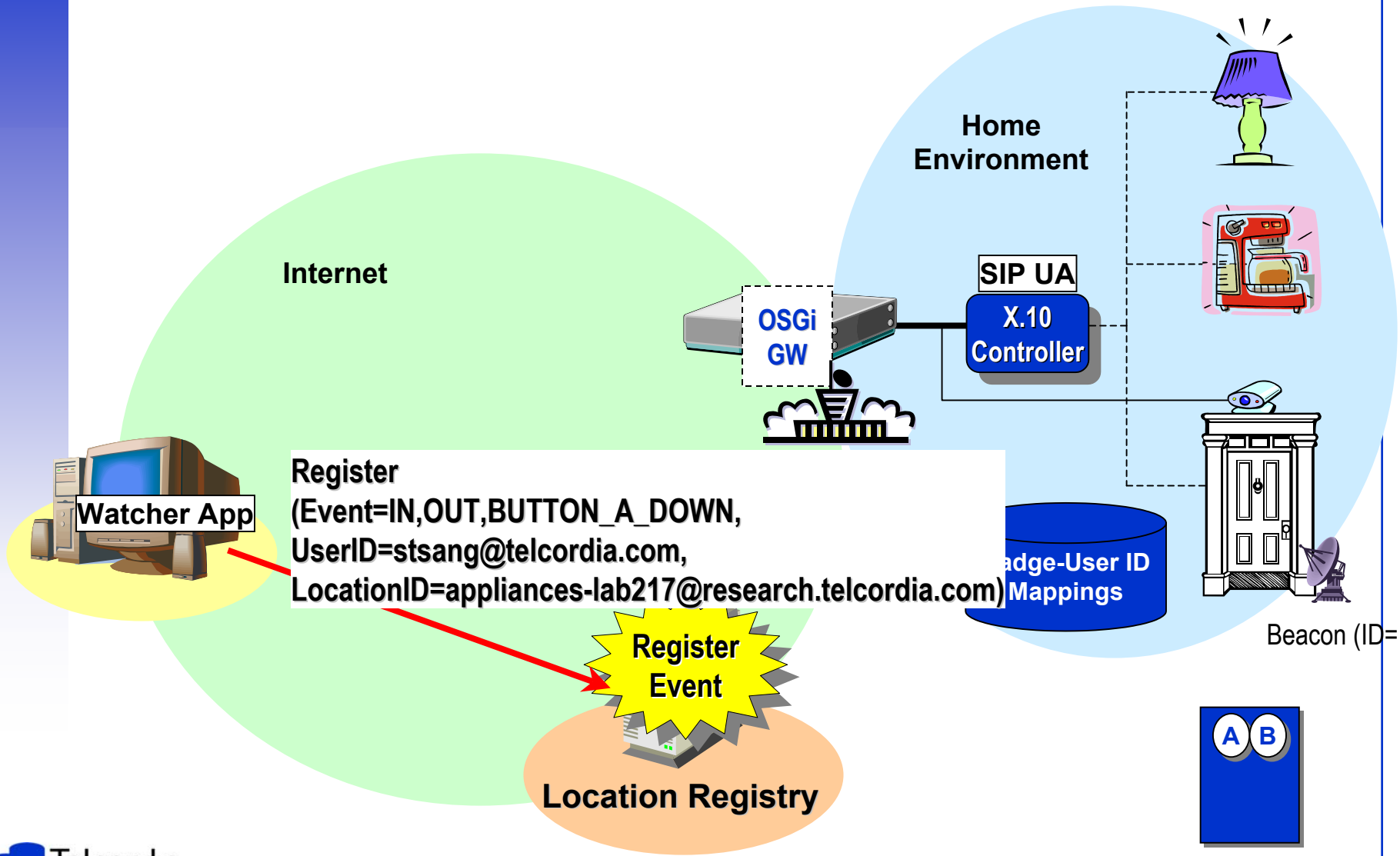
Secure Active Badge Entry - Initialization



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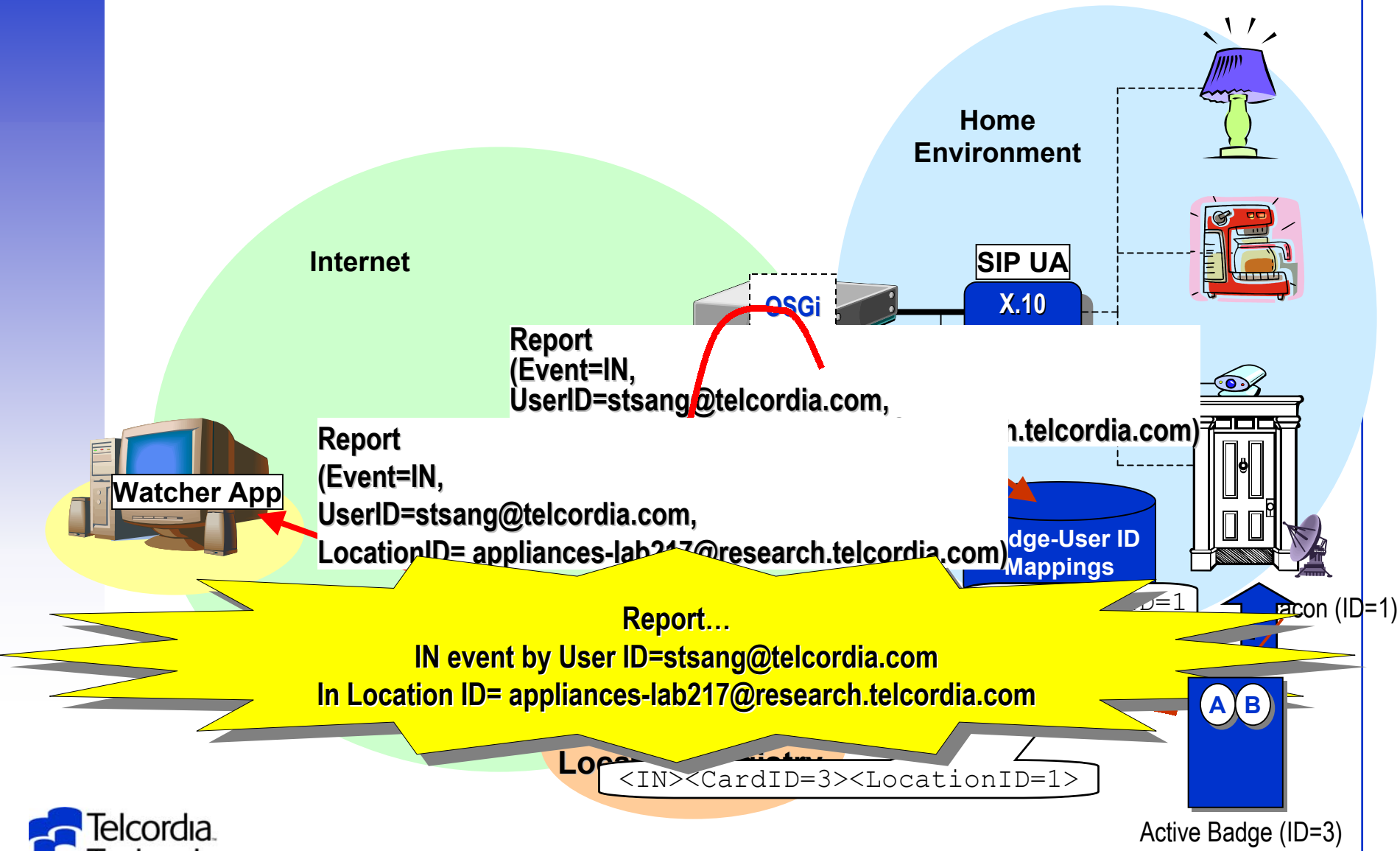
Secure Active Badge Entry – Approach...



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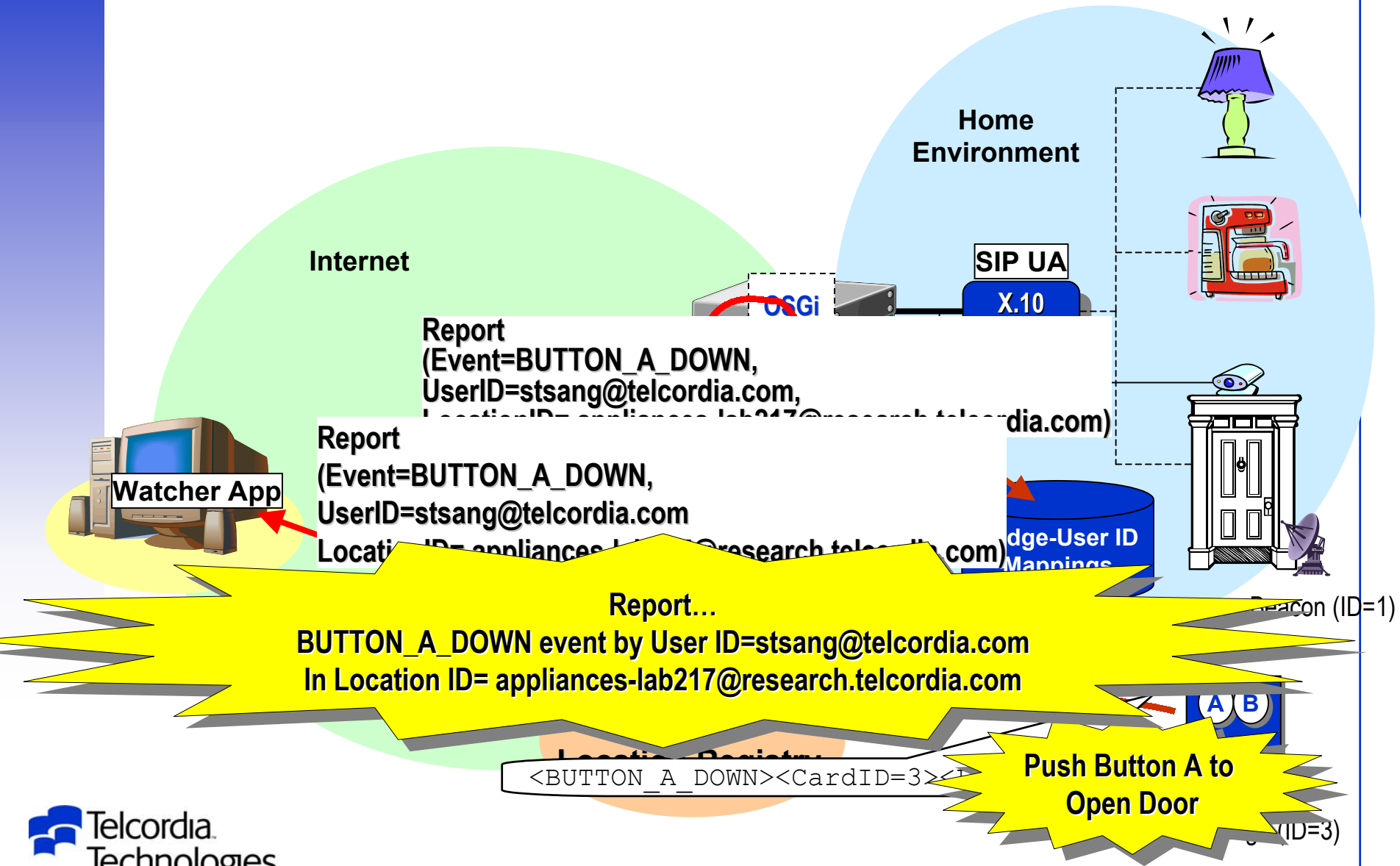
Secure Active Badge Entry – *Open* Request



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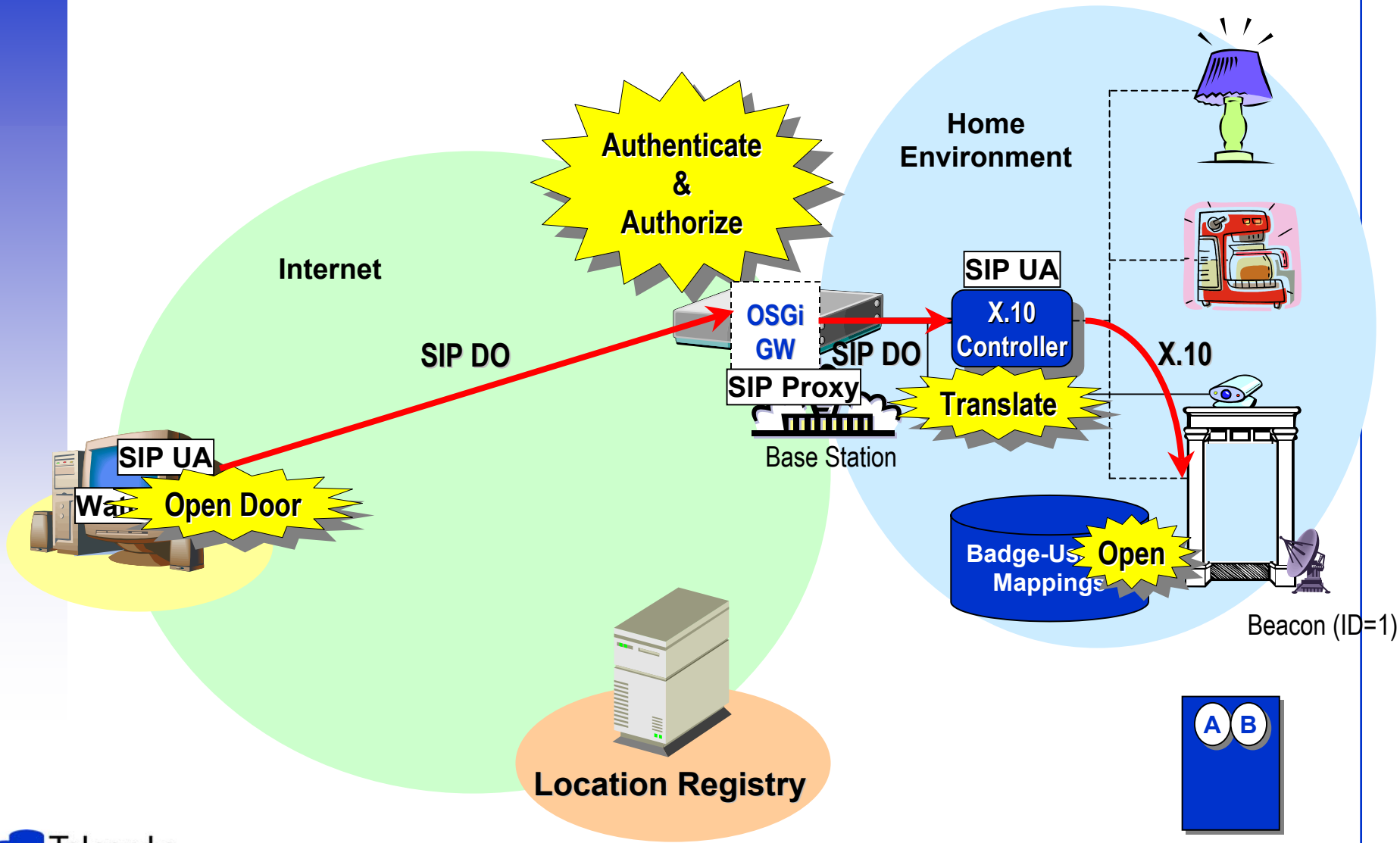
Secure Active Badge Entry – Open Door



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Conclusions

- Telcordia has developed and prototyped infrastructure harnessing the Internet for networked appliances → **Internet Personal Appliances**
  - **SIP++** for *secure* remote control of devices
  - '**Talisman'** micro-location service
  - **OSGi** platform for services
- Technology is applicable in MANY fields
  - Medical
  - Vehicular
  - Military
  - Utilities
  - …

OUTSTANDING ISSUES:

- IPA Naming, Addressing
- IPA Registration & Discovery
- Security
  - Across multiple domains
  - Different policy on a per usage basis?

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Current & Future Work

- Standardization
  - IETF (SIP)
  - OSGi (platform)
  - W5 consortium (Talisman)
- Management of Internet Personal Appliances
  - Service Activation
  - Service Assurance
  - Security and Access

Mailing list: Appliances@research.telcordia.com

Web page: http://www.argreenhouse.com/iapp/

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